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manufacturing technology program

USMC MODERNIZATION INITIATIVES

CURRENT USMC MODERNIZATION INITIATIVES

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SPRAY METALLIZING

DESCRIPTION - Spray Metalizing is a versatile process, which melts alloy metals, and then rapidly propels the molten particles onto a prepared substrate, creating a lamellar or layered coating. The molten spray is developed by an electric arc generated between the ends of two electrically charged wires. High velocity compressed air or other suitable gases atomize the molten particles and project them onto the work piece. Metalizing or thermal spraying as it is often called, is a highly effective and proven method of corrosion protection, giving galvanic as well as barrier coating protection to various substrates.

Phase I testing has been completed at Penn State. Phase II testing is underway at Barstow. Pending the successful completion of Phase II testing a field site will be selected for Phase III testing.

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ROBOTIC PAINTING

DESCRIPTION – An automated positioning system will bring the vehicle into the paint booth, a vision system will utilize pathway programming to identify the vehicle, 3-5 6-axis robots will energize, painting the vehicle in minutes. Mil thickness will be more consistent, there will be zero worker exposure to fumes, and camouflage paint pattern tolerances will be more accurate. An installed plural paint mixing system will allow for quicker and more accurate paint mixtures and metering. Bottlenecks will be reduced and throughput time should improve dramatically.

New facilities, with state-of-the-art air handling equipment are currently being built or planned in both maintenance centers. The designs allow for the future implementation of powder coating equipment and paint stripping initiatives.

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NON DESTRUCTIVE TESTING EQUIPMENT

DESCRIPTION - Identifying welding deficiencies and cracks is a critical part of the repair process. The current problem the USMC is encountering with LAV armor provides an atmosphere of criticality. NSWC is currently evaluating several advancements in non-destructive evaluation (NDE) equipment:

- thermal imaging
- microwave
- real-time
- ultrasound

Compared to the MCs current technique of X-ray technology and equipment the recent developments constitute a dramatic leap forward in capability. NAVSEA is scheduled to conduct a site survey of Albany and Barstow in early FY01 and developing an outline of recommendations and initiatives.

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SHOP FLOOR EXCELLERATOR

DESCRIPTION - The shop floor excellerator/ mentoring device is a type of hand held computer that enables the technician to go on to the floor and conduct assigned repairs with an efficient method of accessing procedures, drawings, and forms. The process can be a "check-off" evolution that ensures all steps and processes are accomplished in the required order and automatically fill out any applicable forms while the repair evolution is completed. It would also provide a "running repair history" of any component or vehicle. This type of technology also allows the USMC maintenance centers to retain institutional skills and technical knowledge.

The USMC is currently attempting to resolve some configuration issues prior to making a commitment.

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WELDING FUME EMISSIONS

DESCRIPTION - Forthcoming proposed restrictions by the EPA and OSHA are going to dramatically reduce the allowable emissions of welding fumes that are generated by the welding process on the shop floor. Cr (VI) (Hexavalent chromium) is a good example; OSHA is preparing to reduce the time weighted average PEL of Cr (VI), currently set at 100 micrograms per cubic meter, to 0.5. Nickel, Manganese, Lead, Cadmium, Beryllium, and Tungsten will also see dramatic reductions in allowable fume emissions. Current processes and equipment will not enable the depots to meet these proposed restrictions.

Recent administration changes in EPA/OSHA are expected to affect the proposed restrictions.

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LIQUID PHASE SINTERING

DESCRIPTION - Liquid Phase Sintering is a cost effective and relatively simple procedure. Two metal powders, one low melting point the other a high melting point, are blended by a heat treatment process and applied to parts in the location that needs to be repaired. The part is locally heated (through various processes) which creates a metallurgically bonded layer that can be machined to achieve the desired tolerances. The thin layer build up minimizes post machining efforts, minimizes underlying part distortion, can be used on odd geometry parts, and provides and unlimited number of repairs. This process is depot deployable and should require little or no changes in the depot flow cycle.

This technology is currently being evaluated for the USMC at the Applied Research Labs at Penn State University

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POWDER COATING

DESCRIPTION – Powder coating is an advanced method of applying paint to a wide variety of materials. Using finely ground powder particles of pigment and resin, the powder is electrostatically sprayed onto the surface to be coated. The charged powder particles adhere to the electrically grounded surface until it fused and heated into a smooth coating in a curing oven. This results in a uniformly durable finish. This is particularly desirable technology for small parts applications.

The Army Research Lab is currently evaluating powder for application to the specs and expect to issue their results soon.
A new paint and prep facility is currently on the drawing board at the Albany Maintenance Center that will incorporate an automated powder coating line.

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LASER WELDING

DESCRIPTION – This technology uses a 3kW Nd: YAG laser beam delivered via fiber optic cable to metallurgically join (or weld). This method of welding produces a significantly decreased heat-affected-zone (HAZ) volume that provides retention of the substrates ballistic protection. At issue is the loss of effective ballistic protection of LAV armor. The LAV high hardness armor plate exhibits a cracking problem that reduces the ballistic penetration protection. Current repairs that utilize conventional processes fix the cracks but still open a ballistic window as a result of the large heat-affected zone (HAZ) associated with the repair process.

This issue has taken on a new gravity and research responsibilities are in the process of being shifted to the LAV Program Managers.

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LASER CUTTING

DESCRIPTION - At issue is the loss of effective ballistic protection of LAV armor. The LAV high hardness armor plate exhibits a cracking problem that reduces the ballistic penetration protection. Current repairs that utilize conventional processes to cut or form the armor plates induce a large heat-affected zone (HAZ). The zone reduces the armors ballistic protection. This technology utilizes a focused high intensity laser beam to cut or shape the armor plates and significantly reduces the HAZ impact.

This process is currently under evaluation by the Applied Research Laboratory at Penn State University.

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HIGH PRESSURE WATER JET CUTTING

DESCRIPTION - This is a new technology that utilizes various axis robots to accomplish abrasive waterjet cutting, high speed milling, and routing. It has a precision positioning system that will provide precise machining and has little or no HAZ impact on the substrate being machined. In addition, the axis robots have the capability of bevel cutting. The issue that this technology will address is primarily targeted at the LAV armor-cracking problem. With a bed extension to 20 ft. and the selection of a five-axis robot entire armor plates can be shaped to fit the LAV. This equipment could bevel all cuts (a pre-weld requirement) and reduce the number of welds required.

Both USMC maintenance centers have HP water jet capability but are restricted by an 8 ft. bed and cutting head without beveling capabilities.

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HALON REPLACEMENT

DESCRIPTION - A potential new issue may be developing regarding the use of halon in fire suppression systems in USMC ground vehicles. As halon is being phased out in the civilian world and with anticipated restrictions from the EPA, the continued use of halon may be in jeopardy. Many DoD organizations are conducting halon alternative studies.

A change in fire extinguishing mediums will inevitably require an upgrade in the depots charging and handling equipment. Until that medium alternative is identified no implementation decisions can be made.

The USMC currently has state-of-the-art capabilities for the recovery, recharging and repair of fire extinguishers for all mediums. We are currently evaluating a plan to expand our storage and handling, and set-up an exchange program to expand our services.

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LEAD (PB) FREE SOLDERING

DESCRIPTION – The USMC has recently initiated a new effort in response to the DoD reduction/elimination of lead based solders. ACI (a ManTech COE) has completed a survey of both maintenance centers and has made recommendations and submitted a proposal to ManTech for funding consideration.

The primary focus will be on operator certification and training for the new IPC standards, Lead Free Solder Program initiatives, and lead waste disposal.

The large percentage of soldering in the USMC maintenance centers is repair and rework. There is very little production and manufacturing evolutions. Rather than commence a major project initiative the Maintenance Directorate intends to follow current lead free projects already underway by other services and agencies and implement changes based on their recommendations.

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CHROMIC ACID REPLACEMENT

DESCRIPTION – Due to the hazardous nature of Chromic acid the USMC maintenance centers have decided to investigate the possibility of a drop-in replacement. An earlier evaluation at the Picatinny Arsenal and the Scranton Army Ammunition Plant produced excellent results. We contacted Oakite Products, Inc. and they made recommendations.

In early January the Albany Maintenance Center replaced the chromic acid in their conversion coating line with an Oakite product called Cryscoat. Additional process changes were also undertaken and evaluation is currently underway. The Barstow Maintenance Center will make the appropriate changes depending upon the results of the Albany experiment.

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SMALL PARTS PAINT STRIPPING

DESCRIPTION – The USMC maintenance centers have eliminated the use of methylene chloride. We are now utilizing blasting to prep small parts for painting. The Maintenance Directorate believes that several initiatives (laser stripping, flashjet, etc.) will eventually provide the desired paint stripping technology but until that is viable, a temporary supplement to the cost and burden of media is needed.

Applied Research Labs of Penn State is currently evaluating several products by various manufacturers for that purpose. Results are expected in late March and it appears that ARL will be able to recommend a safe product that will effectively soften the paint prior to blasting that will significantly reduce our blasting requirements.

Barstow, due to their environmental restrictions, will await the results of Albany's evaluation to make any implementation plans.

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ELIMINATION OF WASHCOATING REQUIREMENTS

DESCRIPTION – The USMC Statements-of-Work for our maintenance centers currently require the application of a washcoat prior to coating. The washcoat "etches" the substrate and provides a surface profile that promotes coating adherence. A decision was made eight years ago to stop washcoating substrates with a surface profile greater than 1.5. But there has been a renewed effort by various technical authorities to return us to the policy of washcoating.

Washcoating was a common practice when chemicals strippers were being utilized. Since the shift to blasting this requirement has become unnecessary. The blasting process provides the 1.5 surface profile that would normally be obtained by washcoating. Considering the extremely hazardous nature of the washcoat formula it's elimination would provide a dramatic environmental advantage.

A PQDR survey was undertaken on vehicle deficiencies and it identified only three hits in the last five years on over 140,000 items that were coated without washcoating.

The Army has already waived the requirement on several of their vehicles and the USMC is currently submitting a waiver to cease usage.

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DEA EXCHANGE

DESCRIPTION - Three areas of concern for the USMC is armor degradation, safer and more efficient methods of coating, and the future of composites. The DEA has recently queried the USMC regarding a technology exchange program with the Ukraine on these subjects.

A plan in principal has been developed (including the other arms of the military) to initiate an effort with the Ukraine. Proposals have been submitted and discussions are currently underway.

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ETHYL LACTATE TESTING

DESCRIPTION - The USMC maintenance centers in Albany and Barstow are currently involved with a JG-PP/CTC effort to evaluate ethyl lactate as a degreaser and possibly as a paint stripper. CTC expects to survey the Barstow Maintenance Center in mid-February and may elect to conduct a follow-on survey at Albany.

The USMC maintenance centers are currently utilizing media blasting as the primary means to depaint. Both maintenance centers would like to find a benign and effective means to either strip or soften paint to reduce our reliance on blasting.

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OTHER ISSUES UNDER EVALUATION

- Sensory Targeting Systems for Firing Range Upgrades
- Renewable Oil Filter Technology
- Workload Modeling System

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5 YEAR – 10 YEAR

TIMELINE

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LASER PAINT STRIPPING

DESCRIPTION - This technology involves the use of a low powered focused laser beam to vaporize the paint coating from a substrate. Utilizing a line-of-sight (LOS) pathway this technology has gotten promising results on large planular applications. The potential also exists for this technology to have a degree of portability.

The USMC is currently involved with a joint effort being conducted by JG-PP between the USAF, Army, NASA, Boeing and Lockheed Martin.

The primary focus is to remove coatings from aircraft. Due to the geometric concerns of USMC ground support equipment, application and implementation will require a different level of testing and evaluation.

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FLASHJET COATING REMOVAL

DESCRIPTION – A new technology is being developed for the purpose of removing paint coatings. Flashjet technology focuses a robotically controlled pulsed light energy source onto the surface to be depainted and ablates the coating. A dry ice process cools and cleans the surface and the effluent is vacuumed into a capture system.

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ION VAPOR DEPOSITED ALUMINUM

DESCRIPTION – This technology has been developed to replace cadmium coatings for the purposes of corrosion control, hydrogen embrittlement, and fatigue reduction. It involves the use of a vacuum chamber pumped down and back filled with argon vapors to effectively clean and degrease the component. The component is then heated and pure aluminum wire is fed into the chamber and vaporized. The process is very versatile and is adaptable to a wide variety of parts, shapes and sizes.

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COMPOSITE REPAIR PROCESSES

DESCRIPTION – The use of composite materials and technology as structural replacements for metals is gaining momentum throughout DoD and industry. Composite materials are lighter in weight and just as structurally sound. The AAAV program already has several composite applications and they are identifying more applications. While the skills are similar to current machining and welding techniques there are enough differences to warrant this as new technology.

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SILICONE CARBIDE IMPREGNATION

DESCRIPTION – This technology is currently being developed by the British to extend the wear life of engine cylinders. The British research is proprietary and the techniques are being reverse engineered by several DoD sources. The technology involves the honing of a cylinder wall to impregnate the surface with a metallurgical bond of silicone carbide. This impregnation will extend the wear life of the cylinder.

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LASER ENGINEERED NET SHAPING

DESCRIPTION – This is an emerging technology that can fabricate three-dimensional metallic components directly from CAD drawings or from solid models with the assistance of enhanced vision systems. The process injects metal powder into a molten pool created by a focused, high-powered laser beam. It can create cross sectional geometries by adding consecutive layers sequentially deposited to create the three dimensional metal component. Fully dense metal components are fabricated directly from raw materials, thereby eliminating intermediate processing steps. In most cases some minor machining is required to provide fine tolerance and surface finishes.

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TELEMAINTENANCE

DESCRIPTION – This technology will allow depot level technicians to assist field personnel in the troubleshooting of electronic components. This technology will reduce the misdiagnosis encountered in the field and improve productivity.

The telemaintenance system is composed of personal and belt computers that are linked through the internet by a wireless local area network. Field units and depot level electronics technicians communicate directly with each other. The belt computers have small multimeters and oscilloscopes to help diagnose problems. With the use of computers and digital cameras field diagnosis will take a dramatic technological leap forward.

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